

BEST AVAILABLE COPY

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
1 April 2004 (01.04.2004)

PCT

(10) International Publication Number
WO 2004/027205 A3

(51) International Patent Classification⁷: **E21B 43/10**

(21) International Application Number:
PCT/US2003/029859

(22) International Filing Date:
22 September 2003 (22.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/412,542 20 September 2002 (20.09.2002) US

(71) Applicant (for all designated States except US): ENVEN-
TURE GLOBAL TECHNOLOGY [US/US]; 16200 A Park
Row, Houston, TX 77084 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **RING, Lev**

[RU/US]; 14126 Heatherhill Place, Houston, TX 77077
(US). **WATSON, Brock, Wayne** [US/US]; 2535 Marsh
Lane #1004, Carrollton, TX 75006 (US). **BRISCO, David,
Paul** [US/US]; 405 Westridge Drive, Duncan, OK 73533
(US).

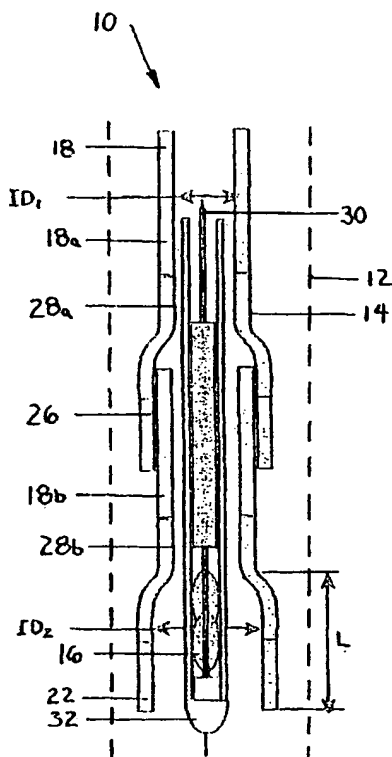
(74) Agent: **MATTINGLY, Todd**; Haynes and Boone, LLP,
Suite 3100, 901 Main Street, Dallas, TX 75202 (US).

(81) Designated States (national): AE, AG, AI, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SK, SL,
TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM,
ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: MONO DIAMETER WELLBORE CASING



(57) Abstract: An apparatus for radially expanding and plastically deform-
ing an expandable tubular members to form a mono diameter wellbore cas-
ing includes an adjustable expansion assembly having a first diameter for
forming a bell portion of in each tubular member and a second diameter
for forming a mono diameter portion that nests into the bell portion of the
preceding tubular member.

WO 2004/027205 A3

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

(88) Date of publication of the international search report:
5 August 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

- of inventorship (Rule 4.17(iv)) for US only

Published:

- with international search report

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/29859

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : E21B 43/10
US CL : 166/380, 207

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 166/380, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,085,838 A (VERCAEMER et al.) 11 July 2000 (11.07.00), figures 5-7.	1-40
A	US 4,420,866 A (MUELLER) 20 December 1983 (20.12.83), figure 4.	1-40

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

Special categories of cited documents:	
* "A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
* "E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
* "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
* "O" document referring to an oral disclosure, use, exhibition or other means	"Z" document member of the same patent family
* "P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

04 February 2004 (04.02.2004)

Date of mailing of the international search report

21 MAY 2004

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized Officer

David Bagnell

Telephone No. (703) 308-1113

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
1 April 2004 (01.04.2004)

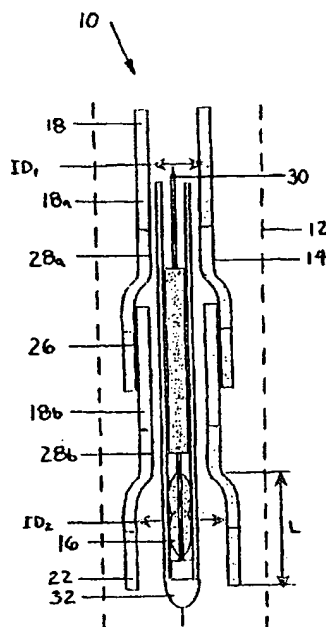
PCT

(10) International Publication Number
WO 2004/027205 A3

- (51) International Patent Classification⁷: E21B 43/10 (74) Agent: MATTINGLY, Todd: Haynes and Boone, LLP, Suite 3100, 901 Main Street, Dallas, TX 75202 (US).
- (21) International Application Number: PCT/US2003/029859 (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.
- (22) International Filing Date: 22 September 2003 (22.09.2003) (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/412,542 20 September 2002 (20.09.2002) US
- (71) Applicant (*for all designated States except US*): ENVENTURE GLOBAL TECHNOLOGY [US/US]; 16200 A Park Row, Houston, TX 77084 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): RING, Lev [RU/US]; 14126 Heatherhill Place, Houston, TX 77077 (US). WATSON, Brock, Wayne [US/US]; 2535 Marsh Lane #1004, Carrollton, TX 75006 (US). BRISCO, David, Paul [US/US]; 405 Westridge Drive, Duncan, OK 73533 (US).
- Declaration under Rule 4.17:
— of inventorship (Rule 4.17(iv)) for US only
- Published:
— with international search report

[Continued on next page]

(54) Title: MONO DIAMETER WELLBORE CASING



(57) Abstract: An apparatus for radially expanding and plastically deforming an expandable tubular members to form a mono diameter wellbore casing includes an adjustable expansion assembly having a first diameter for forming a bell portion of in each tubular member and a second diameter for forming a mono diameter portion that nests into the bell portion of the preceding tubular member.

WO 2004/027205 A3

— with amended claims

(88) Date of publication of the international search report:
5 August 2004

Date of publication of the amended claims:
23 September 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

AMENDED CLAIMS

[received by the International Bureau on 16 July 2004 (16.07.04);
claims 1-40 replaced by amended claims;
claims 41-54 added as new claims; (18 pages)]

1. An apparatus for radially expanding and plastically deforming a portion of an expandable tubular member from an initial inside diameter to a desired inside diameter of a mono diameter section and another portion of the expandable tubular member to an inside diameter of a bell section, wherein the inside diameter of the bell section is greater than the inside diameter of the mono diameter section, comprising:
 - an upper tubular support member defining a first passage;
 - one or more cup seals coupled to the exterior surface of the upper tubular support member for sealing an interface between the upper tubular support member and the expandable tubular member;
 - an expansion cone assembly coupled to the upper tubular support member adjustable to one expansion diameter corresponding to the desired diameter of the bell section and adjustable to another expansion diameter corresponding to the desired diameter of the mono diameter section;
 - means for actuating the expansion cone assembly to adjust from the one diameter to the other diameter; and
 - an actuator for moving the expansion cone assembly through the expandable tubular member a desired distance with the expansion cone assembly adjusted to the desired inside diameter of the bell section and for moving the expansion cone assembly through the expandable tubular member for another distance with the expansion cone assembly adjusted to the desired inside diameter of the mono diameter section.
2. The apparatus of claim 1, wherein the expansion cone assembly comprises a one adjustable cone having an external surface adjustable to the inside diameter of the bell section; and wherein the external surface of the one adjustable cone is also adjustable to the diameter corresponding to the inside diameter of the mono diameter section.
3. The apparatus of claim 1, wherein the expansion cone assembly comprises:
 - a first adjustable cone having an external surface adjustable to the inside diameter of the bell section; and
 - a second adjustable cone having an external surface adjustable to the inside diameter corresponding to the desired diameter of the mono diameter section.

4. The apparatus of claim 1, wherein the expansion cone assembly comprises:
 - a first adjustable cone having an external surface adjustable to the diameter of the bell section and collapsible after expanding the bell section; and
 - a second cone having a fixed diameter corresponding to the desired diameter of the mono diameter section such that collapsing the first adjustable cone effectively adjusts an effective expansion diameter of the expansion cone assembly to the fixed diameter of the second cone.

5. The apparatus of claim 1, wherein the expansion cone assembly comprises:
 - an upper cam assembly coupled to the upper tubular support member comprising:
 - a tubular base coupled to the upper tubular support member; and
 - a plurality of cam arms extending from the tubular base in a downward longitudinal direction, each cam arm defining an inclined surface;
 - a plurality of upper expansion cone segments interleaved with the cam arms of the upper cam assembly and pivotally coupled to the tubular support member, and each upper expansion segment movable relative to the inclined surface of one of the plurality of cam arms to adjust the radial position of an external surface of the segment to adjust the diameter of the expansion cone assembly;
 - a lower tubular support member defining a second passage fluidly coupled to the first passage releasably coupled to the upper tubular support member;
 - a lower cam assembly coupled to the lower tubular support member comprising:
 - a tubular base coupled to the lower tubular support member; and
 - a plurality of cam arms extending from the tubular base in an upward longitudinal direction, each cam arm defining an inclined surface that mates with the inclined surface of a corresponding one of the upper expansion cone segments;
 - wherein the cam arms of the upper cam assembly are interleaved with and overlap the cam arms of the lower cam assembly; and
 - a plurality of lower expansion cone segments interleaved with cam arms of the lower cam assembly, each lower expansion cone segment pivotally coupled to the lower tubular support member and mating with the inclined surface of a corresponding one of the cam arms of the

upper cam assembly and each lower expansion segment movable relative to the inclined surface of one of the plurality of cam arms to adjust the radial position of an external surface of the segment to adjust the diameter of the expansion cone assembly;

wherein the lower expansion cone segments interleave and overlap the upper expansion cone segments; and

wherein the upper and lower expansion cone segments each approximate an arcuate spherical external surface for plastically deforming and radially expanding the expandable tubular member.

6. An apparatus for radially expanding and plastically deforming an expandable tubular member, comprising:

a tubular support member;

a adjustable expansion cone assembly coupled to the tubular support member;

an expandable tubular member coupled to the adjustable expansion cone assembly;

means for displacing the adjustable expansion cone assembly relative to the expandable tubular member; and

means for adjusting the adjustable expansion cone assembly from one effective expansion diameter to another effective expansion diameter.

7. The apparatus of claim 6, wherein the tubular support member comprises an upper tubular support member comprising an internal flange and a lower tubular support member comprising an internal flange; wherein the adjustable expansion cone assembly comprises:

an upper cam assembly coupled to the upper tubular support member comprising:

a tubular base coupled to the upper support member;

a plurality of cam arms extending from the tubular base in a downward longitudinal direction, each cam arm defining an inclined surface; and

a plurality of upper expansion cone segments interleaved with the cam arms of the upper cam assembly and pivotally coupled to the internal flange of the upper tubular support member;

a lower cam assembly coupled to the lower tubular support member comprising:

a tubular base coupled to the lower tubular support member;

a plurality of cam arms extending from the tubular base in an upward longitudinal direction, each cam arm defining an inclined surface that

mates with the inclined surface of a corresponding one of the upper expansion cone segments;

wherein the cam arms of the upper cam assembly are interleaved with and overlap the cam arms of the lower cam assembly; and

a plurality of lower expansion cone segments interleaved with cam arms of the lower cam assembly, each lower expansion cone segment pivotally coupled to the internal flange of the lower tubular support member and mating with the inclined surface of a corresponding one of the cam arms of the upper cam assembly; and

wherein the apparatus further comprises:

means for releasably coupling the upper tubular support member to the lower tubular support member; and

means for limiting movement of the upper tubular support member relative to the lower tubular support member.

8. The apparatus of claim 6, further comprising:
means for pivoting the upper expansion cone segments; and
means for pivoting the lower expansion cone segments.
9. The apparatus of claim 6, further comprising:
means for pulling the adjustable expansion cone assembly through the expandable tubular member.
10. An adjustable expansion cone assembly, comprising:
an upper cam assembly comprising:
a tubular base;
a plurality of cam arms extending from the tubular base in a downward longitudinal direction, each cam arm defining an inclined surface; and
a plurality of upper expansion cone segments interleaved with the cam arms of the upper cam assembly;
a lower cam assembly comprising:
a tubular base;
a plurality of cam arms extending from the tubular base in an upward longitudinal direction, each cam arm defining an inclined surface that

mates with the inclined surface of a corresponding one of the upper expansion cone segments;

wherein the cam arms of the upper cam assembly are interleaved with and overlap the cam arms of the lower cam assembly; and

a plurality of lower expansion cone segments interleaved with cam arms of the lower cam assembly, each lower expansion cone segment mating with the inclined surface of a corresponding one of the cam arms of the upper cam assembly;

means for moving the upper cam assembly toward or away from the lower expansion cone segments to adjust the radial position of an external surface of the lower expansion cone segments; and

means for moving the lower cam assembly toward or away from the upper expansion cone segments to adjust the radial position of an external surface of the upper expansion cone segments.

11. The apparatus of claim 10, wherein the upper and lower expansion cone segments together approximate an arcuate spherical external surface.
12. The apparatus of claim 10, wherein each upper expansion cone segment comprises:
 - an inner portion defining an arcuate cylindrical upper surface and arcuate cylindrical lower surfaces;
 - an intermediate portion defining arcuate cylindrical and spherical upper surfaces and an arcuate conical lower surface; and
 - an outer portion defining arcuate cylindrical upper and lower surfaces; andwherein each lower expansion cone segment comprises:
 - an inner portion defining an arcuate cylindrical upper surface and arcuate cylindrical lower surfaces;
 - an intermediate portion defining arcuate cylindrical and spherical upper surfaces and an arcuate conical lower surface; and
 - an outer portion defining arcuate cylindrical upper and lower surfaces.
13. The apparatus of claim 12, wherein each upper expansion cone segment is tapered in the longitudinal direction from the intermediate portion to the outer portion; and wherein

each lower expansion cone segment is tapered in the longitudinal direction from the intermediate portion to the outer portion.

14. An apparatus for radially expanding and plastically deforming a portion of an expandable tubular member from an initial inside diameter to a desired inside diameter of a mono diameter section and another portion of the expandable tubular member to a desired inside diameter of a bell section, wherein the inside diameter of the bell section is greater than the inside diameter of the mono diameter section, comprising:

- an upper tubular support member defining a first passage;
- one or more cup seals coupled to the exterior surface of the upper tubular support member for sealing an interface between the upper tubular support member and the expandable tubular member;
- an expansion assembly coupled to the upper tubular support member adjustable to one expansion diameter corresponding to the desired inside diameter of the bell section and adjustable to another expansion diameter corresponding to the desired inside diameter of the mono diameter section;
- means for actuating the expansion assembly to adjust from the one diameter to the other diameter; and
- an actuator for moving the expansion assembly through the expandable tubular member a desired distance with the expansion assembly adjusted to the inside diameter of the bell section and for moving the expansion assembly through the expandable tubular member for another distance with the expansion assembly adjusted to the desired diameter of the mono diameter section.

15. The apparatus of claim 14, wherein the expansion assembly comprises a expansion cone device

16. The apparatus of claim 14, wherein the expansion assembly comprises a rotary expansion device.

17. The apparatus of claim 14, wherein the expansion assembly comprises compliant expansion device.

18. The apparatus of claim 14, wherein the expansion assembly comprises a hydroforming expansion device.
19. The apparatus of claim 14, wherein the expansion assembly comprises an adjustable expander device adjustable to the inside diameter of the bell portion of the expandable tubular member; and wherein the one adjustable expander device is also adjustable to the diameter corresponding to the desired inside diameter of the mono diameter wellbore casing.
20. The apparatus of claim 19, wherein the adjustable expander device comprises an adjustable expansion cone device
21. The apparatus of claim 19, wherein the adjustable expander device comprises an adjustable rotary expansion device.
22. The apparatus of claim 19, wherein the adjustable expander device comprises an adjustable compliant expansion device.
23. The apparatus of claim 19, wherein the adjustable expander device comprises an adjustable hydroforming expansion device.
25. The apparatus of claim 14, wherein the expansion assembly comprises a first adjustable expander device adjustable to the inside diameter of the bell section of the expandable tubular member; and a second adjustable expander device adjustable to the inside diameter corresponding to the desired diameter of the mono diameter section.
26. The apparatus of claim 14, wherein the expansion assembly comprises:
a first adjustable expander device adjustable to the desired inside diameter of the bell section of the expandable tubular member and collapsible after expanding the bell section; and
a second expander device having a fixed diameter corresponding to the desired inside diameter of the mono diameter section such that collapsing the first adjustable expander device effectively adjusts the effective expansion diameter to the fixed diameter of the second expander device.

27. A method of forming a mono diameter casing in a wellbore, comprising:
- supporting a first expandable tubular member in the wellbore using a tubular support member and an adjustable expansion assembly having a first diameter smaller than the inside diameter of the expandable tubular member;
 - injecting a fluidic material into the tubular support member;
 - sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;
 - displacing the adjustable expansion assembly relative to the expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;
 - sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;
 - adjusting the effective expansion diameter of the adjustable expansion assembly to a second diameter larger than the inside diameter of the expandable tubular member when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;
 - moving the adjustable expansion assembly having the second diameter a predetermined distance into the expandable tubular member to radially expand and plastically deform a first portion of the expandable tubular member;
 - activating the effective expansion diameter of the adjustable expansion assembly to adjust to a second diameter smaller than the first effective expansion diameter; and
 - moving the adjustable expansion assembly through the expandable tubular member when the adjustable expansion assembly is adjusted to the third diameter, to thereby radially expand and plastically deform the remaining portion of the expandable tubular member.
28. The method of forming a mono diameter wellbore casing as in claim 27 further comprising:
- supporting a second expandable tubular member in the wellbore using a tubular

support member and an adjustable expansion assembly having a first diameter smaller than the inside diameter of the expandable tubular member; positioning the second expandable tubular member in the expanded first expandable tubular member with the first portion thereof overlapping the second expandable tubular member;

injecting a fluidic material into the tubular support member;

sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;

displacing the adjustable expansion assembly relative to the second expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;

sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;

adjusting the effective expansion diameter of the adjustable expansion assembly to the second diameter when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;

moving the adjustable expansion assembly having the second diameter a predetermined distance into the second expandable tubular member to radially expand and plastically deform a first portion of the second expandable tubular member below the first portion of the first expandable tubular member;

activating the effective expansion diameter of the adjustable expansion assembly to adjust to the second diameter; and

moving the adjustable expansion assembly through the second expandable tubular member and past the portion overlapping with the first expandable tubular member when the adjustable expansion assembly is adjusted to the third diameter, and to thereby radially expand and plastically deform a second portion of the second expandable tubular member to the same diameter as the expanded remaining portion of the first expandable tubular member.

29. The method of claim 27, wherein the adjustable expansion assembly comprises an adjustable expansion cone device

30. The apparatus of claim 27, wherein the adjustable expansion assembly comprises an adjustable rotary expansion device.
31. The method of claim 27, wherein the adjustable expansion assembly comprises an adjustable compliant expansion device.
32. The method of claim 27, wherein the adjustable expansion assembly comprises an adjustable hydroforming expansion device.
33. A method of forming a casing in a wellbore, comprising:
inserting an expandable tubular member into the wellbore
radially expanding and plastically deforming a lower portion of the expandable tubular member to a first inside diameter; and
radially expanding and plastically deforming an upper portion of the expandable tubular member to a second inside diameter, wherein the first inside diameter is larger than the second inside diameter.
34. The method of claim 33 further comprising:
inserting a second expandable tubular member, into the expanded expandable tubular member so that a top portion of the second expandable tubular member is overlapped by the expanded lower portion of the expanded expandable tubular member; and
expanding the top portion of the second expandable tubular member to the second diameter so that the top portion of the second expandable tubular member is expanded radially outward in the expanded lower portion of the expanded expandable tubular member.
35. The method of claim 33, wherein expanding the lower and upper portions of the expandable tubular members comprises expanding using an expansion cone device.
36. The method of claim 33, wherein expanding the lower and upper portions of the expandable tubular members comprises expanding using a rotary expansion device.
37. The method of claim 33, wherein expanding the lower and upper portions of the

expandable tubular members comprises expanding using a compliant expansion device.

38. The method of claim 33, wherein expanding the lower and upper portions of the expandable tubular members comprises expanding using a hydroforming expansion device.

39. A method of forming a mono diameter casing in a wellbore, comprising:
supporting a first expandable tubular member in the wellbore using a tubular support member and an adjustable expansion cone assembly having a first diameter smaller than the inside diameter of the expandable tubular member;
injecting a fluidic material into the tubular support member;
sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;
displacing the adjustable expansion cone assembly relative to the expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;
sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;
adjusting the effective expansion diameter of the adjustable expansion cone assembly to a second diameter larger than the inside diameter of the expandable tubular member when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;
moving the adjustable expansion cone assembly having the second diameter a predetermined distance into the expandable tubular member to radially expand and plastically deform a first portion of the expandable tubular member;
activating the effective expansion diameter of the adjustable expansion cone assembly to adjust to a second diameter smaller than the first effective expansion diameter; and
moving the adjustable expansion cone assembly through the expandable tubular member when the adjustable expansion cone assembly is adjusted to the third diameter, to thereby radially expand and plastically deform the remaining portion of the expandable tubular member.

40. The method of forming a mono diameter wellbore casing as in claim 39 further comprising:

- supporting a second expandable tubular member in the wellbore using a tubular support member and an adjustable expansion cone assembly having a first diameter smaller than the inside diameter of the expandable tubular member;
- positioning the second expandable tubular member in the expanded first expandable tubular member with the first portion thereof overlapping the second expandable tubular member;
- injecting a fluidic material into the tubular support member;
- sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;
- displacing the adjustable expansion cone assembly relative to the second expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;
- sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;
- adjusting the effective expansion diameter of the adjustable expansion cone assembly to the second diameter when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;
- moving the adjustable expansion cone assembly having the second diameter a predetermined distance into the second expandable tubular member to radially expand and plastically deform a first portion of the second expandable tubular member below the first portion of the first expandable tubular member;
- activating the effective expansion diameter of the adjustable expansion cone assembly to adjust to the second diameter; and
- moving the adjustable expansion cone assembly through the second expandable tubular member and past the portion overlapping with the first expandable tubular member when the adjustable expansion cone assembly is adjusted to the third diameter and to thereby radially expand and plastically deform a second portion of the second expandable tubular member to the same

diameter as the expanded remaining portion of the first expandable tubular member.

41. A system for forming a mono diameter casing in a wellbore, comprising:
- means for supporting a first expandable tubular member in the wellbore using a tubular support member and an adjustable expansion means having a first diameter smaller than the inside diameter of the expandable tubular member;
 - means for injecting a fluidic material into the tubular support member;
 - means for sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;
 - means for displacing the adjustable expansion means relative to the expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;
 - means for sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;
 - means for adjusting an effective expansion diameter of the adjustable expansion means to a second diameter larger than the inside diameter of the expandable tubular member when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;
 - means for moving the adjustable expansion means having the second diameter a predetermined distance into the expandable tubular member to radially expand and plastically deform a first portion of the expandable tubular member;
 - means for activating the effective expansion diameter of the adjustable expansion means to adjust to a second diameter smaller than the first effective expansion diameter; and
 - means for moving the adjustable expansion means through the expandable tubular member when the adjustable expansion means is adjusted to the third diameter, to thereby radially expand and plastically deform the remaining portion of the expandable tubular member.

42. The system of claim 41, further comprising:
- means for supporting a second expandable tubular member in the wellbore using a tubular support member and an adjustable expansion means having a first diameter smaller than the inside diameter of the expandable tubular member;
 - means for positioning the second expandable tubular member in the expanded first expandable tubular member with the first portion thereof overlapping the second expandable tubular member;
 - means for injecting a fluidic material into the tubular support member;
 - means for sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;
 - means for displacing the adjustable expansion means relative to the second expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;
 - means for sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;
 - means for adjusting the effective expansion diameter of the adjustable expansion means to the second diameter when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;
 - means for moving the adjustable expansion means having the second diameter a predetermined distance into the second expandable tubular member to radially expand and plastically deform a first portion of the second expandable tubular member below the first portion of the first expandable tubular member;
 - means for activating the effective expansion diameter of the adjustable expansion means to adjust to the second diameter; and
 - means for moving the adjustable expansion means through the second expandable tubular member and past the portion overlapping with the first expandable tubular member when the adjustable expansion assembly is adjusted to the third diameter, and to thereby radially expand and plastically deform a second portion of the second expandable tubular member to the same diameter as the expanded remaining portion of the first expandable tubular member.

43. The system of claim 41, wherein the adjustable expansion means comprises an adjustable expansion cone means.
44. The system of claim 41, wherein the adjustable expansion means comprises an adjustable rotary expansion means.
45. The system of claim 41, wherein the adjustable expansion means comprises an adjustable compliant expansion means.
46. The system of claim 41, wherein the adjustable expansion means comprises an adjustable hydroforming expansion means.
47. A system for forming a casing in a wellbore, comprising:
means for inserting an expandable tubular member into the wellbore
means for radially expanding and plastically deforming a lower portion of the expandable tubular member to a first inside diameter; and
means for radially expanding and plastically deforming an upper portion of the expandable tubular member to a second inside diameter, wherein the first inside diameter is larger than the second inside diameter.
48. The system of claim 47, further comprising:
means for inserting a second expandable tubular member into the expanded expandable tubular member so that a top portion of the second expandable tubular member is overlapped by the expanded lower portion of the expanded expandable tubular member; and
means for expanding the top portion of the second expandable tubular member to the second diameter so that the top portion of the second expandable tubular member is expanded radially outward in the expanded lower portion of the expanded expandable tubular member.
49. The system of claim 47, wherein means for expanding the lower and upper portions of the expandable tubular members comprises expanding using an expansion cone means.

50. The system of claim 47, wherein means for expanding the lower and upper portions of the expandable tubular members comprises rotary expansion means.
51. The system of claim 47, wherein means for expanding the lower and upper portions of the expandable tubular members comprises compliant expansion means.
52. The system of claim 47, wherein means for expanding the lower and upper portions of the expandable tubular members comprises hydroforming expansion means.
53. A system for forming a mono diameter casing in a wellbore, comprising:
means for supporting a first expandable tubular member in the wellbore using a tubular support member and an adjustable expansion cone means having a first diameter smaller than the inside diameter of the expandable tubular member;
means for injecting a fluidic material into the tubular support member;
means for sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;
means for displacing the adjustable expansion cone means relative to the expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;
means for sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;
means for adjusting the effective expansion diameter of the adjustable expansion cone means to a second diameter larger than the inside diameter of the expandable tubular member when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;
means for moving the adjustable expansion cone means having the second diameter a predetermined distance into the expandable tubular member to radially expand and plastically deform a first portion of the expandable tubular member;

means for activating the effective expansion diameter of the adjustable expansion cone means to adjust to a second diameter smaller than the first effective expansion diameter; and

means for moving the adjustable expansion cone means through the expandable tubular member when the adjustable expansion cone means is adjusted to the third diameter, to thereby radially expand and plastically deform the remaining portion of the expandable tubular member.

54. The system of claim 53, further comprising:

means for supporting a second expandable tubular member in the wellbore using a tubular support member and an adjustable expansion cone means having a first diameter smaller than the inside diameter of the expandable tubular member;

means for positioning the second expandable tubular member in the expanded first expandable tubular member with the first portion thereof overlapping the second expandable tubular member;

means for injecting a fluidic material into the tubular support member;

means for sensing the operating pressure of the injected fluidic material within a first interior portion of the tubular support member;

means for displacing the adjustable expansion cone means relative to the second expandable tubular member and into the wellbore when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the first interior portion of the tubular support member;

means for sensing the operating pressure of the injected fluidic material within a second interior portion of the tubular support member;

means for adjusting the effective expansion diameter of the adjustable expansion cone means to the second diameter when the sensed operating pressure of the injected fluidic material exceeds a predetermined level within the second interior portion of the tubular support member;

means for moving the adjustable expansion cone means having the second diameter a predetermined distance into the second expandable tubular member to radially expand and plastically deform a first portion of the second expandable tubular member below the first portion of the first expandable tubular member;

means for activating the effective expansion diameter of the adjustable expansion cone means to adjust to the second diameter; and

means for moving the adjustable expansion cone means through the second expandable tubular member and past the portion overlapping with the first expandable tubular member when the adjustable expansion cone assembly is adjusted to the third diameter, and to thereby radially expand and plastically deform a second portion of the second expandable tubular member to the same diameter as the expanded remaining portion of the first expandable tubular member.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.